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**Subject:** Kalamazoo River 11/14 Work Group Call - Discussion Materials  
**Date:** Wednesday, November 13, 2013 4:35:33 PM  
**Attachments:** [2013 11 13 Area 1 Fish Projection Methodology.docx](#)  
[2013 11 12 Area 1 Tables 1-6 Selection Summary.xlsx](#)  
[2013 11 13 A1 SMB\\_Fillet\\_SWACbased reg.xlsx](#)  
[2013 11 13 A1 SMBYOYWB\\_SWACbased reg.xlsx](#)  
[2013 11 13 A1 CarpFillet\\_SWACbased reg.xlsx](#)

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Discussion materials for tomorrow's (11/14) 3 PM EST Kalamazoo River Work Group call are attached.

As a reminder, call in info is as follows:

Conf Call: 866-324-4184 Access Code: 5987685

Thanks!

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### **Fish Projection Methodology**

Fish trending was conducted for six groupings of fish samples defined herein as fish trending ABSAs. These fish trending ABSAs were chosen to represent Area 1 as presented in the FS and are named as follows: ABSA-03, ABSA-04, ABSA-05, Urban 1, Urban 2, and Dams. Urban and Dams designations were used to separate the river into two similar segments where Urban represents the free-flowing portion of the Kalamazoo starting in an urban area near Portage Creek and Dams represents the quiescent portion of the Kalamazoo near the two Plainwell dams. The regression equations for these six fish trending ABSAs were used to project future fish tissue concentrations in Area 1. The original ABSA boundaries were established in *Final (Revised) Baseline Ecological Risk Assessment – Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Site-wide BERA)* CDM (2003a) and the Urban and Dams fish trending ABSAs were developed through suggestions during discussions from the Working Group. The fish trending ABSAs are defined as follows:

ABSA-03: Morrow Lake Dam to Mosel Avenue  
ABSA-04: Mosel Avenue to Hwy 131 Bridge  
ABSA-05: Hwy 131 Bridge to Former Plainwell Dam  
Urban 1: Kalamazoo Avenue to D Avenue  
Urban 2: Kalamazoo Avenue to Mosel Avenue  
Dams: D Avenue to Former Plainwell Dam

Each ABSA included one or multiple fish collection location(s). These collection locations are included in the fish trending ABSAs as follows:

| Fish Trending ABSAs | Fish Sampling Locations         |                           |                     |                   |                                |                              |
|---------------------|---------------------------------|---------------------------|---------------------|-------------------|--------------------------------|------------------------------|
|                     | ABSA-3 Downstream of Morrow Dam | ABSA-3.5 Kalamazoo Avenue | ABSA-4 Mosel Avenue | ABSA-4.5 D Avenue | ABSA-4.6 Plainwell #2 Dam Area | ABSA-5 Plainwell Impoundment |
| ABSA-03             | X                               | X                         |                     |                   |                                |                              |
| ABSA-04             |                                 |                           | X                   | X                 | X                              |                              |
| ABSA-05             |                                 |                           |                     |                   |                                | X                            |
| Urban 1             |                                 | X                         | X                   | X                 |                                |                              |
| Urban 2             |                                 | X                         | X                   |                   |                                |                              |
| Dams                |                                 |                           |                     |                   | X                              | X                            |

### **Initial Fish Concentrations**

Initial fish tissue concentrations for the fish types were calculated using the most recent years of data. Projections were performed starting at one of two possible initial fish concentrations: Urban and Dams. The median of fish tissue concentrations for the Urban and Dams Areas was calculated from 2006 - 2011 data. Starting concentrations are:

| Areas | Smallmouth Bass Fillet | Smallmouth Bass Young of Year Whole Body | Common Carp Fillet |
|-------|------------------------|--|--------------------|
| Urban | 0.22                   | 0.73                                     | 4.1                |
| Dams  | 0.38                   | 1.3                                      | 3.3                |

### **Fish Concentration Thresholds**

A number of fish concentration thresholds are highlighted to aid the risk manager in selecting the remedial alternative. These concentrations are based on reference concentrations upstream of Area 1, ecological or human health risk-based concentrations, and Michigan fish consumption advisory level guidelines. Upstream reference concentrations were calculated as the median of the most recent year of data for each fish type for fish collected in Morrow Lake and in Ceresco Reservoir. The concentrations used as thresholds are:

|  | <b>Smallmouth Bass Fillet</b> | <b>Smallmouth Bass Young of Year Whole Body</b> | <b>Common Carp Fillet</b> |
|--|-------------------------------|---|---------------------------|
| Mink RBC*  | NA                            | 0.60  | NA                        |
| Morrow Lake Reference*                                     | 0.23 (2012)                   | 0.34 (2006)                                     | 0.29 (2012)               |
| Human Health Fish Consumption RBC: High End Sports Angler* | 0.20                          | NA  | 0.12                      |
| Ceresco Reservoir Reference*                               | 0.026 (2006)                  | 0.12 (2006)                                     | 0.13 (2006)               |
| MDCH Fish Consumption Advisory: 2 meals per month*         | 0.11                          | NA  | 0.11                      |

RBC = Risk-based Concentration

NA = Not applicable

\*All concentrations are in mg/kg

(Year) of median concentration

### **Remediation and Step Down**

Remedial activities and the average time frame within which these occur are discussed in Section 4.2 of the Area 1 FS. Step down concentrations were calculated via three methods to match the Mid, Upper Bound, and Lower Bound scenarios. A loglinear regression equation was used to calculate the step down for the Mid scenario, a 10 percent sediment to fish ratio was used to calculate the step down for the Upper Bound scenario, and a biota-sediment accumulation factor (BSAF) was used to calculate the step down for the Lower Bound scenario.

For the Mid scenario, fish concentrations post-remedial activities were calculated based on sediment concentrations pre- and post-remediation, fish concentrations prior to remedial activities, and the regression coefficient provided for each species by Kern (Enclosure 1 of MDEQ comments; MDEQ, 2013) as follows:

$$C_{fish(post)} = C_{fish(pre)} * \left( \frac{C_{sediment(post)}}{C_{sediment(pre)}} \right)^{\beta_3}$$

Where  $\beta_3 = 0.62$  for smallmouth bass fillets,  $\beta_3 = 0.61$  for smallmouth bass young of year whole body, and  $\beta_3 = 0.73$  for common carp fillets.

For the Upper Bound scenario, a 10 percent sediment to fish ratio, based on Bryant Mill Pond data, was used to calculate the change in fish concentrations. This step down is dependent on the change in sediment concentrations from pre- to post-remedial activities. Post-remediation sediment concentrations decreased by two orders of magnitude from pre-remediation sediment concentrations at Bryant Mill Pond (Enclosure 1 of MDEQ comments; MDEQ, 2013). Post-remediation fish concentrations decreased by one order of magnitude from pre-remediation fish concentrations at Bryant Mill Pond (Enclosure 1 of MDEQ comments; MDEQ, 2013). This results in a ratio of 0.10 (fish:sediment) or 10 percent. The change in fish concentrations was calculated as 10 percent of the difference in pre- and post-remedial activity SWACs for

sediment. The SWACs specific to Sections 2, 3 and 4 where remedial activities are proposed were used for S-3 and S-4 calculations in the Urban Area and the Area-wide SWACs (Table 4-3 of the Area 1 FS) were used for S-5 for the Urban and Dams Areas.

For the Lower Bound scenario, a BSAF of 1 was used to calculate the change in fish concentrations. The average fish BSAF on Table 4-8 of the BERA (CDM, 2003a) was used. The BSAF step down is dependent on the change in sediment concentrations pre- and post-remedial activities. The change in fish concentrations was calculated as 100 percent (1:1) of the difference in pre- and post-remedial activity SWACs for sediment. The SWACs specific to Sections 2, 3 and 4 where remedial activities are proposed were used for S-3 and S-4 calculations in the Urban Area and the Area-wide SWACs (Table 4-3 of the Area 1 FS) were used for S-5 for the Urban and Dams Areas.

### **Projected Fish Concentration Reductions**

Regression equations from fish trending ABSAs in the urban portions of the river (ABSA-03, ABSA-04, Urban 1, or Urban 2) were used to project fish concentrations for each of the remedial alternatives that affect the urban environment. Regression equations from fish trending ABSAs in the impounded or previously impounded portions of the river (ABSA-05 or Dams) were used to project fish concentrations for each of the remedial alternatives that affect the Dams Area. The following criteria were used to select the appropriate regression equations for the six ABSAs representative of Area 1. Selections are summarized on Tables 1, 3, and 5. Tables 2, 4 and 6 presents the reduction percentages that each selected regression equation represents to facilitate the understanding of fish projections by the public.

### **Projection Criteria:**

- Regression equations were statistically tested for significance and those significantly different than zero ( $p < 0.05$ ) were considered for potential use to project declines for the most likely concentration reduction scenario (Mid).
- Monitored Natural Recovery (MNR) percentages were selected as follows:
  - The regression equation that resulted in the median average annual percent decline (AAPD) was selected to represent the Mid decline. If only two significant regression equations were available, the lower of the AAPDs was selected to calculate a conservative projection.
  - The lower confidence limit (LCL) of the regression equation with the lowest AAPD was selected to represent the “upper bound” of time.
  - The upper confidence limit (UCL) of the regression equation with the highest AAPD was selected to represent the “lower bound” of time.
- Recovery percentages were selected as follows:
  - Upper Bound: The AAPD was used from the Mid scenario for MNR.
  - Mid: An AAPD was used with a power equation (i.e., calculated like reverse compound interest). The selected AAPD was greater than the Mid AAPD for MNR and less than the AAPD for the lower bound.
  - Lower Bound: The UCL of the highest AAPD from MNR was retained for the “lower bound”.

### Rationale for Regression Line Selection

#### **Smallmouth Bass Fillet – Urban Area**

##### **S-2:**

Mid: Used Urban 2 regression ( $p=0.053$ ) acceptable at alpha = 0.10 ( $p < 0.1$ ).

Upper Bound: At least one regression was not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations.

Lower Bound: The ABSA-03 regression line was significantly different than zero so the UCL of this regression was used to project the fastest potential rate of tissue decline for the lower bound.

##### **S-3:**

Mid: Used Urban 2 regression ( $p=0.053$ ) acceptable at alpha = 0.10 ( $p < 0.1$ ). A value of 2.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: At least one regression was not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. Urban 2 was used as the recovery percentage.

Lower Bound: The ABSA-03 regression line was significantly different than zero so the UCL of this regression was used to project the fastest potential rate of tissue decline for the lower bound. ABSA-03 UCL was used as the recovery percentage.

##### **S-4:**

Mid: Used Urban 2 regression ( $p=0.053$ ) acceptable at alpha = 0.10 ( $p < 0.1$ ). A value of 2.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: At least one regression was not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. Urban 2 was used as the recovery percentage.

Lower Bound: The ABSA-03 regression line was significantly different than zero so the UCL of this regression was used to project the fastest potential rate of tissue decline for the lower bound. ABSA-03 UCL was used as the recovery percentage.

##### **S-5:**

Mid: Used Urban 2 regression ( $p=0.053$ ) acceptable at alpha = 0.10 ( $p < 0.1$ ). A value of 4 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: At least one regression was not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. Urban 2 was used as the recovery percentage.

Lower Bound: The ABSA-03 regression line was significantly different than zero so the UCL of this regression was used to project the fastest potential rate of tissue decline for the lower bound. ABSA-03 UCL was used as the recovery percentage.

#### **Smallmouth Bass Fillet – Dams Area**

##### **S-2:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero.

Upper Bound: Used the lowest LCL of the two AAPDs that were from regression lines significantly different than zero.

Lower Bound: Used the highest UCL of the two AAPDs that were from regression lines significantly different than zero.

**S-3:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

**S-4:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

**S-5:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero. A value of 4 percent for recovery consistent with the Urban Area recovery was selected for use in a power equation.

Upper Bound: Used the lowest LCL of the two AAPDs that were from regression lines significantly different than zero. ABSA-05 regression line was used as the recovery percentage.

Lower Bound: Used the highest UCL of the two AAPDs that were from regression lines significantly different than zero. Dams UCL of the regression was used as the recovery percentage.

### **Smallmouth Bass Young of Year Whole Body – Urban Area**

**S-2:**

Mid: All regression lines were not significantly different than zero. The regression for ABSA-03 was used because the regression was significantly different than zero ( $p = 0.057$ ) at an alpha of 0.10.

Upper Bound: All regression lines were not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations.

Lower Bound: All regression lines were not significantly different than zero. The UCL of the regression for ABSA-03 was used since the only regression significantly different than zero ( $p = 0.057$ ) when an alpha value of 0.10 was considered.

**S-3:**

Mid: All regression lines were not significantly different than zero. The regression for ABSA-03 was used because the regression was significantly different than zero ( $p = 0.057$ ) at an alpha of 0.10. A value of 3.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: All regression lines were not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. ABSA-03 regression line was used as the recovery percentage.

Lower Bound: All regression lines were not significantly different than zero. The regression for ABSA-03 was used since the only regression significantly different than zero ( $p = 0.057$ ) when an alpha value of 0.10 was considered. The ABSA-03 UCL of the regression was used as the recovery percentage.

**S-4:**

Mid: All regression lines were not significantly different than zero. The regression for ABSA-03 was used because the regression was significantly different than zero ( $p = 0.057$ ) at an alpha of 0.10. A value of 3.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: All regression lines were not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. ABSA-03 regression line was used as the recovery percentage.

Lower Bound: All regression lines were not significantly different than zero. The regression for ABSA-03 was used since the only regression significantly different than zero ( $p = 0.057$ ) when an alpha value of 0.10 was considered. The ABSA-03 UCL of the regression was used as the recovery percentage.

**S-5:**

Mid: All regression lines were not significantly different than zero. The regression for ABSA-03 was used because the regression was significantly different than zero ( $p = 0.057$ ) at an alpha of 0.10. A value of 4.5 percent for recovery that was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: All regression lines were not significantly different than zero, so an AAPD of zero was used to indicate no change in fish concentrations. ABSA-03 regression line was used as the recovery percentage.

Lower Bound: All regression lines were not significantly different than zero. The regression for ABSA-03 was used since the only regression significantly different than zero ( $p = 0.057$ ) when an alpha value of 0.10 was considered. The ABSA-03 UCL of the regression was used as the recovery percentage.

**Smallmouth Bass Young of Year Whole Body – Dams Area**

**S-2:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero.

Upper Bound: Used the lowest LCL of the two AAPDs that were from regression lines significantly different than zero.

Lower Bound: Used the highest UCL of the two AAPDs that were from regression lines significantly different than zero.

**S-3:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

**S-4:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

**S-5:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero. A value of 3.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: Used the lowest LCL of the two AAPDs that were from regression lines significantly different than zero. Dams regression line was used as the recovery percentage.

Lower Bound: Used the highest UCL of the two AAPDs that were from regression lines significantly different than zero. ABSA-05 UCL of the regression was used as the recovery percentage.

### **Common Carp Fillet – Urban Area**

#### **S-2:**

Mid: The median AAPD was used.

Upper Bound: The lowest LCL of the regression lines was used.

Lower Bound: The highest UCL of the regression lines was used.

#### **S-3:**

Mid: The median AAPD was used. A value of 3.5 percent for recovery that was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: The lowest LCL of the regression lines was used. Urban 1 regression line was used as the recovery percentage.

Lower Bound: The highest UCL of the regression lines was used. ABSA-03 UCL of the regression was used as the recovery percentage.

#### **S-4:**

Mid: The median AAPD was used. A value of 3.5 percent for recovery that was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: The lowest LCL of the regression lines was used. Urban 1 regression line was used as the recovery percentage.

Lower Bound: The highest UCL of the regression lines was used. ABSA-03 UCL of the regression was used as the recovery percentage.

#### **S-5:**

Mid: The median AAPD was used. A value of 3.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: The lowest LCL of the regression lines was used. Urban 1 regression line was used as the recovery percentage.

Lower Bound: The highest UCL of the regression lines was used. ABSA-03 UCL of the regression was used as the recovery percentage.

### **Common Carp Fillet – Dams Area**

#### **S-2:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero.

Upper Bound: Used the lower LCL of the two AAPDs that were from regression lines significantly different than zero.

Lower Bound: Used the higher UCL of the two AAPDs that were from regression lines significantly different than zero.

#### **S-3:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

#### **S-4:**

No time projection calculated for this scenario because no remedial activities occur in the Dams Area for this alternative.

**S-5:**

Mid: Used the lower of the two AAPDs that were from regression lines significantly different than zero. A value of 3.5 percent for recovery was between the upper and lower bounds and based on the scale of the remedial alternative was selected for use in a power equation.

Upper Bound: Used the lower LCL of the two AAPDs that were from regression lines significantly different than zero. Dams regression line was used as the recovery percentage.

Lower Bound: Used the higher UCL of the two AAPDs that were from regression lines significantly different than zero. ABSA-05 UCL of the regression was used as the recovery percentage.

**References**

CDM. 2003a. *Final (Revised) Baseline Ecological Risk Assessment – Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Site-Wide BERA)*. Prepared on behalf of the MDEQ Remediation and Redevelopment Division. April 2003.

Michigan Department of Environmental Quality (MDEQ). 2013. Enclosure 1: Temporal Trends and Analysis of Selected Remedial Alternatives for Area 1 of the Kalamazoo River Superfund Site *in* MDEQ comments for Draft Area 1 Feasibility Study Report – Morrow Dam to Former Plainwell Dam, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. February 15, 2013.

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